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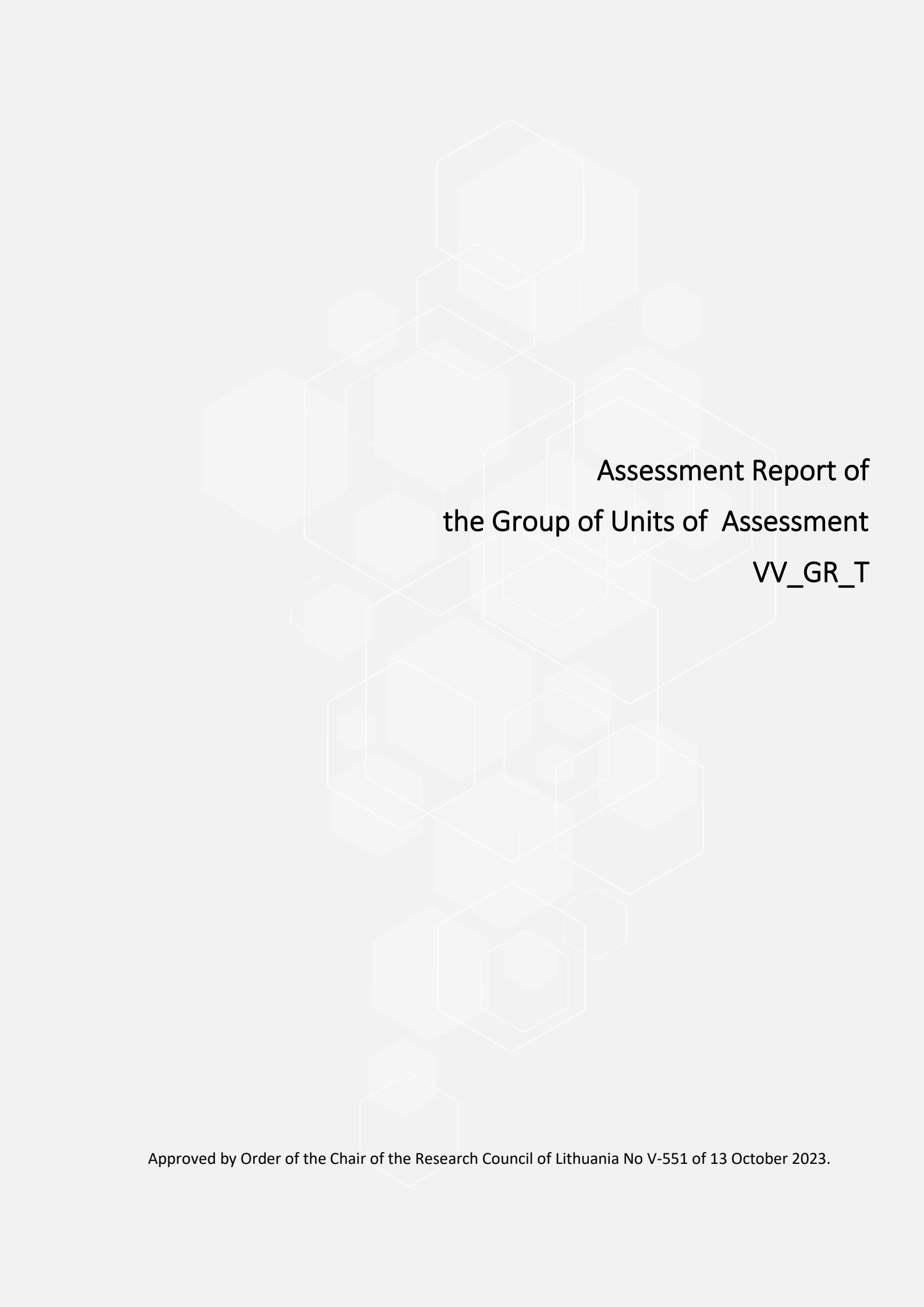
**Assessment Report of
Comparative Expert
Assessment of Research
and Development Activities
Carried out by Universities
and Research Institutes for
the Group of Units of
Assessment VV_GR_T**

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**Assessment Report of
the Group of Units of Assessment
VV_GR_T**

Approved by Order of the Chair of the Research Council of Lithuania No V-551 of 13 October 2023.

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Terms & Abbreviations

CEA – Comparative Expert Assessment of research and development activities carried out by Lithuanian universities and research institutes

FTE – Full-Time Equivalent

Institutions – Lithuanian universities and research institutes

RCL – Research Council of Lithuania

R&D – Research and Development

UoA; Unit(s) – Unit(s) of Assessment

FTE¹ – the number of working hours worked during the year by a certain group of employees divided by a number of working hours in the 12 months of that year, as set by the Minister of Social Security and Labour (with a 5-working-day week). <.> The FTE unit – a person per year.

FTE(SD)¹ – the sum of the FTE of teaching staff members with a science degree divided by 3, and the FTE of research workers and other researchers with a scientific degree.

Research area:

T – Technology

Universities:

KTU – Kaunas University of Technology

Vilnius Tech – Vilnius Gediminas Technical University

Research Institute:

LEI – Lithuanian Energy Institute

¹ *Description of the Comparative Expert Assessment of Research and Development Activities by Universities and Research Institutes* approved by Order No V-1593 of the Minister of Education, Science and Sport of 2 September 2021

1. INTRODUCTION

1.1. Purpose, Scope, Goals of the Comparative Expert Assessment

The Comparative Expert Assessment of research and development activities carried out by universities and research institutes of Lithuania (hereinafter – CEA) was carried out in 2023 by Research Council of Lithuania (hereinafter – RCL) in accordance with the *Description of the Comparative Expert Assessment of Research and Development Activities by Universities and Research Institutes* approved by Order No V-1593 of the Minister of Education, Science and Sport of 2 September 2021 (hereinafter – the Description), the *Regulation on Procedures for the Comparative Expert Evaluation of Research and Development Activities Carried out by Universities and Research Institutes* approved by Order No V-486 of the Chair of the RCL of 8 August 2022 (hereinafter – the Regulation), and other related legislation.

The purpose of CEA is to provide a picture of research and development (hereinafter – R&D) performance, socio-economic impact, and the development potential of Lithuanian universities and research institutes (hereinafter – Institutions) based on their R&D activities during the period of 2018–2022.

The scope of CEA encompasses both state and non-state Institutions operating in Lithuania. All state universities (in total eleven) and all state research institutes (in total eleven as well), four non-state universities and two non-state research institutes were participating in the CEA in 2023. The Institutions or parts thereof were assessed as the units of assessment (hereinafter – UoA or Units). The CEA facilitates the comparison of R&D performance of the UoA against international standards and within the national context. It provides valuable evidence to R&D policymakers at different levels, as well as offers the Institutions involved in the assessment a significant incentive to enhance their performance.

Since 2018, the CEA has been an integral part of assessment of R&D activities of Lithuanian institutions. The annual assessment of R&D activities carried out by the Institutions together with CEA conducted every five years constitutes the Lithuanian assessment system of R&D activities. The results of the two-step assessment are used to allocate state funding for R&D activities for Institutions. The results of the CEA implemented in 2023 will determine 70% of state budget funding for R&D activities of Institutions for the subsequent five years.

The assessment results will also determine the continuity of doctoral studies as well as the new rights to carry out doctoral studies at Institutions in accordance with the *Regulations on Doctoral Studies* approved by Decision No. V-739 of the Minister of Education, Science and Sport of 18 May 2020. Moreover, the findings from the CEA might serve as a trusted source of evidence on R&D performance of the Institutions for assessments concerning other funding instruments or higher education studies.

1.2. Comparative Expert Assessment Organization and Assessment Criteria

The CEA relies on international peer review panels to evaluate Lithuanian Institutions' R&D activities. Using panels rather than individual peers creates a possibility for discussion and debate within the peer group and enabling comparison within the group.

The assessment is carried out on the UoA level, which is the organisationally defined structure – ranging from a whole Institution to a division of an Institution corresponding to the faculty or other formal structures of the Institution. In accordance with the Description the rules for the formation of the UoA are as follows:

- the UoA should be interrelated by common R&D activities and might operate in one or two research areas;
- the minimum size of the UoA should be no less than 5 full-time researchers with scientific degree (FTE(SD)) and the maximum size of UoA should not exceed 75 FTE(SD).

The exceptions could be made for better reflection of R&D activities in the Institution. If an Institution had a UoA with a higher number of FTE(SD) or/and UoA operated in three research areas, it should have submitted arguments and obtained RCL approval for participating with not typical composition.

Following the instructions, Institutions have formed eighty-five UoA. All these UoA were split into thirteen groups resulting from four to nine UoA per Panel. The interval of the UoA size ranged from slightly above 5 FTE(SD) to UoA of more than 150 FTE(SD). The number of research areas and research fields one UoA was operating in also varied, i. e., while most UoA operated in one or two research fields, there were outliers where Units were involved in up to five research fields. The variations in size, composition, and research areas among the UoA within each group posed challenges for comparison and required careful consideration by the Expert Panel.

The assessment of the Units is based on three criteria:

- The quality of R&D activities (weight 0.65) of UoA in the research field(s) (group of research fields);
- The economic and social impact of R&D activities (weight 0.2) of UoA;
- The development potential of R&D activities (weight 0.15) of UoA.

The quality of R&D activities is assessed either in each research field or the group of research fields within the research area while economic and social impact as well as development potential are assessed on the UoA level. Each assessment criterion is scored on a five-point scale, namely, ranging from excellent [5] to poor [1] or no R&D [0]. The description of the values of the scores for each criterion are provided in the Description. Half point scores were allowed, and that provided a possibility for more nuanced assessment when necessary.

The quality of R&D activities of the Unit is assessed following these rules: if UoA has at least 10 FTE(SD) in the research field or has between 2 and 10 FTE(SD) and has the right to provide doctoral studies (or intends to seek such right in the next 5 years) in the research field, then the research quality is assessed in the research field; if UoA does not meet these criteria, then the research quality is assessed in the group of research fields within the research area. In the latter case, the assessment considers the collective quality across the research fields within the group.

The assessment was based on the material provided by the UoA to the RCL information system “Vieversys” and covered the period 2018–2022, as well as summarized results of the annual assessment of R&D activities of Institutions (for 2018–2021) provided by RCL, alongside the information obtained during the visits of the Panels to the Institutions and meetings with the representatives of the UoA. Following the Description and the *Procedure for the Submission of Data on Results of Research and Development Activities Carried out by Universities and Research Institutes for the Comparative Expert Assessment* approved by Order No V-1593 of the Minister of Education, Science and Sport of 2 September 2021 (hereinafter – the Procedure for Submission of Data) relevant data was examined when assessing the UoA against each of the CEA criteria. In most cases the number of provided outputs for the assessment depended on the size of the UoA varying from a minimum of five to maximum of eighty-two outputs.

It should be noted that since the previous round of CEA in 2018, several organisational improvements of assessment have been made, therefore caution should be exercised when comparing the results of these two assessments. Some of them are worth mentioning:

- 85 UoA were formed and grouped into 13 Expert Panels in 2023, while the first CEA resulted in 117 UoA formed and grouped into 6 Expert Panels. The cause is mainly due to the change of rules for setting up a UoA. During the 2018 CEA, forming a UoA was allowed in only one respective research area, i. e., if the UoA operated in two research areas, it had to be split into two Units for the assessment purposes. In 2023 this restriction was eliminated, and Unit could easily operate in two (and in some cases in three) research areas. As well UoA formation was influenced by changing landscape of Institutions during the assessment period as mergers of several institutions took place: Aleksandras Stulginskis University and the Lithuanian University of Educational Sciences merged with Vytautas Magnus University since 1st January 2019; Šiauliai University was merged with Vilnius University, as well as the Institute of Law, the Lithuanian Institute of Agrarian Economics and the Lithuanian Social Research Center were merged into Lithuanian Centre for Social Sciences since 1st January 2021.
- The CEA scoring system has also undergone some changes. While five-point scales were used in both assessments, in 2023 half points were allowed, while in 2018 only whole numbers were used.
- There were some changes in the requirements for documentary input. In 2023 one list of Unit's R&D outputs for a five-year period was required while in 2018 a list of R&D outputs for each assessment year (from 2013 to 2017) and an additional list for the entire assessment period were required, resulting in a large volume of data.

1.3. Expert Panel for the VV_GR_T Group of Units of Assessment

The Expert Panel for the VV_GR_T group had to assess six UoA from three Institutions:

- **Kaunas University of Technology** – 1 UoA:
Mechanics, Transport, Energy (abbr. *KTU_Mech-transp-energ*),
Civil Engineering (abbr. *KTU_Statyba*);
- **Vilnius Gediminas Technical University** – 1 UoA:
Aviation, Mechanics and Transport Engineering (abbr. *VilniusTech_AMTE*),
Civil Engineering (abbr. *VilniusTech_CE*),
Environmental Engineering (abbr. *VilniusTech_EE*);
- **Lithuanian Energy Institute** – 1 UoA:
Energy (abbr. *LEI_energ*).

The Units were operating in the Energetics and Power Engineering, Mechanical Engineering, Civil Engineering, Materials Engineering, Transport Engineering, and Environmental Engineering research fields, and considering these research fields RCL has appointed the Expert Panel members with the main responsibility to assess UoA against three criteria and provide recommendations for UoA future development. The Panel consisted of ten members affiliated with institutions abroad:

- Leonid Dubrovinsky (Panel Chair), University of Bayreuth, Germany
- Peter Frigaard, Aalborg University, Denmark
- Adnan Ibrahimbegovic, University of Technology of Compiègne, France
- Dawid Janas, University of Silesia, Poland
- Dimitrios Karamanis, University of Patras, Greece
- Piotr Lapka, Warsaw University of Technology, Poland
- Michael Petrou, University of Cyprus, Cyprus
- Marina Pinheiro, University of Porto, Portugal

- Bernhard Schneider, University for Continuing Education Krems, Austria
- Efthimios Zervas, Hellenic Open University, Greece.

1.4. Assessment Organization for the VV_GR_T Group of Units of Assessment

Timeline of the assessment organization for the VV_GR_T Group of UoA:

Submission of data. Institutions participating in the VV_GR_T Group submitted data on R&D activities of their UoA to the information system “Vieversys” by the 9th of March 2023 following the Procedure for Submission of Data.

Individual assessment. Prior to the visit to Lithuania, the data of each UoA submitted for the assessment was individually evaluated by at least three experts from the Panel. The number of experts assigned to assess each UoA would increase based on the number of research fields within the UoA. The individual assessment of the Units within the VV_GR_T Group was conducted till 3rd of May 2023.

Visit to Lithuania. The Panel members for the VV_GR_T Group visited Lithuania from the 8th to 12th of May 2023. The main objectives of the visit included discussing the results of the individual assessment within the Expert Panel, ensuring a uniform and consistent application of the assessment criteria among the Panel members; visiting and familiarizing with the academic and administrative staff, PhD students, and research infrastructure of the UoA (at least three experts from the Panel had to visit one UoA); and collectively agreeing on all scores for the Units within the group in the joint session.

Final report. After the visit to Lithuania, the preparation of the Panel report took place. The coordination of the preparation was done by the Panel chair. Before the submission of the Panel’s report, the institutions were given an opportunity to provide comments on the factual errors if any observed in the written justification of the scores for UoA. Taking into consideration the comments, the Panel's report has been adjusted where necessary. In addition, the Panel prepared a reply to the commenting authorities. The report was submitted to the RCL with the agreement of all Panel members.

Appeals. Upon receiving the final results on each Unit, the Institutions had the right to submit a substantiated appeal to the RCL if they believed there were factual errors in the justification of the UoA assessment and/or if they suspected a breach of the assessment procedures that may have affected the assessment outcome.

RCL has established an external Board of Appeal, comprised of seven members selected from the candidates nominated by the Lithuanian Research Academy, the Conference of Rectors of Lithuanian Universities, the Conference of Directors of the Lithuanian National Research Institutes, and the Ministry of Education, Science, and Sports. The Board of Appeal was responsible for determining whether the appeals adhered to the specified provisions and in case of favourable decision to examine the appeal thoroughly.

The Panel VV_GR_T has not received any appeals.

Approval of the report. The final report of the VV_GR_T group is approved by the Order of the Chair of the RCL in accordance with the Regulation.

2. ASSESSMENT REPORTS

2.1. LEI_energ Unit of Assessment

Name of the institution	Lithuanian Energy Institute
Official abbreviation of the name of the institution	LEI
Name of the Institution's unit of assessment (hereinafter – UoA)	Energy
Abbreviation of the UoA name	LEI_energ
The scope of the UoA (FTE(SD))	94,59
Research area(s)	T 000 - Technology

Quality of the R&D activities by research fields (groups of research fields) of the UoA

Technology

Research field	Scope (FTE(SD))	Score (points)
T 006 - Energetics and Power Engineering	77,49	4

Reasoned justification of the score

The UoA in Energetics and Power Engineering is very strong at the national and international levels but has limited recognition abroad. The UoA is internationally very active in the nuclear and fusion energy fields and comprehensive in combustion technologies (including gasification and biomass) at a level of a large (centralized) scale, e.g., power plant scale. However, research on other nowadays important Energetics and Power Engineering branches, e.g., renewable energy sources and energy storage, especially at the small (distributed) local scale, e.g., at the district or building level scale, are not comprehensively addressed.

The UoA conducts doctoral studies. However, number of defended theses is relatively low considering the FTE number assigned to the research field and the secured research projects. The theses topics are in line with the field. There were no defended PhD theses by students from abroad, and a small share of dissertations was written in English, which does not show good internationalization of doctoral studies conducted by UoA. There are currently 25 full-time PhD students, including 4 from abroad, which is moderate considering the UoA FTE number. The number of PhD students is increasing yearly, which shows a good perspective for UoA.

The employment structure is adequate. However, the numbers of FTE for research fellows and junior researchers are very low. Lack of research fellows and post-docs from abroad is the sign of limited international recognition of UoA.

The list of the best research outputs consists of several dozens of chapters in recognized books and papers in Q1 and Q2 journals, including many with very high impact factors. The topics of the papers are in line with the research field. Several papers were highly cited, showing a good impact of the research conducted, but

some papers have not been well quoted. Papers with co-authors from other institutions reflect good national and international cooperation. Participation in multinational experiments as in nuclear fusion is also an opportunity for UoA internalization. The research staff actively participates in local and worldwide international conferences. But the share of reported indexed conference publications is very small, despite some conferences having indexed proceedings. Moreover, there is no information about invited or plenary lectures. The Unit's staff obtained several awards, mainly national (e.g., from the Ministry of the Lithuanian government, Lithuanian Academy of Sciences) or for recognition of conference contributions. Considering FTE, these achievements are moderate. No important international awards, nominations, orders, or honorary titles were shown. Research project implementations are very good. An impressive number of EU-funded projects (H2020, Horizon Europe) show good cooperation within Europe. However, a large number of projects are related to nuclear and fusion research fields. Research projects do not well cover the other UoA research areas, which is the weakness of UoA. Also, the number of coordinated projects is low, showing that UoA is not an internationally leading institution. Number of competition-based nationally funded projects is also limited.

Research field	Scope (FTE(SD))	Score (points)
T 004 - Environmental Engineering	9,35	3,5

Reasoned justification of the score

The UoA in Environmental Engineering is very strong at the national level but has not so clear recognition abroad. The employment structure of the Environmental Engineering group includes mainly senior and chief researchers as its personnel and less researchers. Although a small group, the researchers of the unit have a good record of scientific accomplishments, they bring considerable experience and competence with publications in scientific journals and conference proceedings.

Although the number of defended dissertations is low in the assessment period, the number of students increased substantially in this period and some from abroad, indicating that these doctoral courses appear attractive. The lack of junior researchers and fellows (including those from abroad) is a disadvantage, even though this is to some extent compensated by a large group of PhD students.

Environmental engineering research in the Unit is mainly focused on hydrological studies and the interaction with hydropower and climate change as, e.g., the study of characteristics of floods in Lithuania, the environmental impact of hydropower on Lithuanian rivers, the impact of climate change on hydropower and sludge remediation studies. Therefore, the R&D of the field in the unit deals with the important global issues of environment-energy-climate change.

The best research outputs are published in journals with high impact factors and articles were cited by the scientific community but not highly. The topics of the papers are in line with the research field. Upon closer inspection of the researchers' CVs, a significant proportion of their work appears to be published in lower-tier journals, which could potentially diminish the Unit's global reach and research impact. Contributions in top journals, which can influence a multidisciplinary audience or European and international patents are not evident in the list of best research outputs.

Researchers of the Unit are collaborating both within LEI and researchers abroad in their documented and published research work which is very important for the recognition and networking support of the research field. The list of the best reports delivered at conferences abroad indicates the broad scientific communication of the R&D research results on the field with a sufficient number of conferences of different level, including international but limited and not shown to be organized under the auspices of recognized

international organizations/associations. The level of engagement and character of these contributions does not include invited keynote or plenary presentations. The Unit is actively involved in national and limited international competitive projects, although a small FTE group for supporting the research field. The Unit has received a few national awards, including one membership in the Lithuanian Academy of Science, indicating its research impact at the national level.

Group of research fields within the research area	Scope (FTE(SD))	Score (points)
T 008 - Materials Engineering	7,75	3

Reasoned justification of the score

The UoA is strong with limited international recognition.

The employment structure of the Material Engineering group includes senior researchers and researchers and no other categories (no chief researchers, no junior researchers or researcher fellows or from abroad at the reference years). The Unit consists of a small number of researchers (with notable success in their research endeavours) and does not conduct doctoral studies.

Main areas of Unit's research during the reported period include the reliability of power plant facilities, development and research of multifunctional materials and composites, testing of materials, assessment and analysis of their qualitative indicators. Recent R&D activities in material engineering combine with the activities of the energy engineering field with the utilization of biomass residues in the cement industry. The activities are mainly directed in applied research in line with the research field and publications in high impact journals, well respected in the field (e.g., Construction and Building Materials, Journal Cleaner Production, Solar Energy Materials & Solar Cells) and well appreciated and cited from the scientific community according to the provided best results outcomes. However, the contribution of the group is not shown to be significant in the submitted publication information since a major part of the best results articles refers to the same first author under a common affiliation with Kaunas University of Technology and small share of the research output attributable to the Unit. No patents are reported in the list of best research outputs.

The list of the best reports delivered at conferences shows adequate scientific communication of R&D research results in the field with presentations mainly in Europe and general conferences. However, dissemination by conference participation is less impressive as it does not include invited plenary or keynote talks. Moreover, the list of conferences abroad in which the group submitted as those of best delivered reports, does not include conferences organized under the auspices of recognized international organizations/associations while the share of indexed conference publications is not significant. Additionally, no national and international awards received for research and development are evident.

During this period, while the degree of engagement in project realization is relatively small, the group secured some research funding from EU sources but has not received any national grants. The details of the participation in the competition-based R&D projects include research funding from Baltic Research Programme and small grants from Euratom during the reported period mainly related to Ignalina Nuclear Power Plan wider studies.

Economic and social impact of R&D activities of the UoA

Score (points)

4

Reasoned justification of the score

The UoA demonstrated several outputs which can increase impact on society and the economy in the upcoming future. These outputs deal with energy, so they are fully in line with the focus of the Institute. LEI's research infrastructure is well-equipped with state-of-the-art laboratories. Interesting and well-cited scientific research is conducted by LEI scientists, but there is also room for improvement, especially with results of higher scientific research significance and publication in journals of higher impact. There are several industrial contracts that are obviously important although the economic and social impact of the LEI could be more pronounced.

In services, LEI is active in the analysis of the stability of the grid system and power supply reliability study for industrial partners, safety analysis of NPP while funded R&D could potentially be transformed to innovation in collaboration to industry: biomethane production technology; production of gaseous biofuels; integrated smart ecosystem; development of very large tanks and reactors with cavitation mixing; new duplex steel tank semi-trailer; study of hydrological droughts; R&D on plasma hazardous waste treatment; metrology and reference laboratories. In this context, start-up & spin-off companies on products & services and transformation of collaboration activities with industry into long-term partnerships should be more emphasized.

The Unit is actively involved in providing consultation services and undertaking various projects through its laboratories. The Unit organizes an annual international conference of young scientists on energy and natural sciences, but no other significant national or international conferences or scientific events are shown to be present during the assessment period. LEI's researchers hold membership positions in local associations while they are active on editorial boards, primarily in regional and lower quartile journals. Many of these journals are exclusively Lithuania-based and decrease the wider impact of these contributions. In contrast, the Unit's involvement with boarding members as national representatives in international scientific and technical committees and working groups contributes to its international recognition. This direction is also promoted by the extensive cooperation agreements of the Unit, bilateral with Institutes from several countries, Memorandum of Understanding with professional societies and EU countries, agreements and memberships at research alliances.

LEI is well-recognized at the national level as documented by numerous awards. Additionally, the Institute is committed to promoting science through various science popularization activities at mostly national media. Although the Unit is present in social networks, the activity in these media is not sufficient, especially considering the large number of projects implemented.

Therefore, the UoA is very important player in conducting socially relevant scientific research and has established robust collaborations with academic, industry, and government partners. The UoA carries out very important scientific research and is a very important partner in R&D beyond the academic community.

The development potential of R&D activities of the UoA

Score (points)

4

Reasoned justification of the score

LEI is established as a national open-access scientific research centre for future energy technologies in the knowledge triangle at science, business and higher-education valley, an important initiative for joining forces and open labs in services. Additional infrastructure for individual researchers is in place with the availability of extended networks through the participation in national R&D infrastructure and international alliances and European associations. Notable are the green campus and further initiatives under planning as small hydrogen valleys with the recommendation of moving to a net zero or even positive energy campus.

Personnel is balanced among researchers and other employees and PhD students with a centroid at the very productive R&D period and employees even younger. However, the numbers of research fellows (including those from abroad), junior researchers, and PhD students, especially from abroad, are insufficient. Gender imbalance with the underrepresentation of women in both categories needs particular attention and actions for future development.

Management principles on recruitment are properly based on open competitions under the principle that all procedures are transparent, non-discriminatory, and inclusive. Openness of LEI laboratories to researchers from other institutions is important for the cultivation of innovation in research and the revealing of new ideas. PhD studies and PhD students are at the core of the process and of particular consideration in LEI's recruitment plan with novel motivation channels and attraction networks for talented new staff. However, there is no information on how young researchers with scientific degree are encouraged to continue their scientific careers at UoA and how they are supported.

The strategic objectives of the Institute are well established with scientific (fundamental and applied) and technological activities at the forefront of research & sustainable development on the field of renewable energy and its interaction to environment, climate change, economy, safety and climate-neutral society. The Unit's research priorities are in line with both national and EU strategies, and the successful implementation of these priorities could significantly enhance the Unit's reputation both nationally and internationally.

To achieve its objectives, the Unit has developed a strategic research plan that focuses on attracting more PhD students, securing more national and international research funding, and enhancing international collaboration. In this context, the strategic operating plan of LEI is driven by its vision to ensure international excellence in the fields of technology and social sciences. Standard Operating Procedure (SOP) is regularly submitted for fundamental and applied R&D and doctoral studies based on specific KPIs achievement under a certified quality management system.

LEI possesses all the necessary conditions to be established as a reference research Institute for the training of new generation of researchers. On the implemented and planned actions, the establishment of a continuous annual and transparent recruitment process for PhD funded positions is important for strengthening LEI position in R&D&I. In the process, the elimination of mixed responsibilities and explicit assignment of the relevant topics to relevant laboratories topics or merging of laboratories could be supportive. The Unit has also emphasized the importance of quality over quantity in its policy to train young researchers, which is a positive approach.

SWOT analysis is very fair and accurate. Especially weaknesses are carefully described. The LEI is aware of its weaknesses and threats, which is very positive while recognizes properly its strengths and opportunities. More UoA weaknesses to be improved include the attraction of postdocs, the increase of PhD students and

research fellows from abroad, the number of research outcomes with clear and significant socio-economic impacts, the cooperation with well-known national and abroad research organizations, the organizing of broader scientific by the UoA, the enhanced representation in editorial boards of recognized and high journals, and the regular social media activity. By prioritizing international collaboration and attracting more funding, the Unit can further strengthen its position as a research leader. Overall, the Unit appears to be on the right track, but it may need to address its gender imbalance to foster a more diverse and inclusive research environment.

Recommendations for continuity and/or improvement of the activities of the UoA

-In the research field of Energetics and Power Engineering, the expansion to wind and solar power research to support national plans is recommended with new funding opportunities in EU calls for Innovation and cross-border programs in renewable energy.

-In the research field of Environmental Engineering, the study of the impact of climate change on natural resources can be expanded to adaptation measures and connected to mitigation with renewable energy technologies and carbon-neutral cities; national results of the triangle environment-energy-climate change could be compared with international results; publishing journals of higher impact factor should be selected while the group is encouraged to extend the competitive R&D projects in EU programmes.

- In the research field of Material Engineering, the publication record of the group should be extended to high-impact journals; applications on EU funding efforts to core activities of scientific and technological innovations in the field of material engineering should be intensified.

- Inter-disciplinary research collaboration of LEI's laboratories with joining forces and common publications should be further developed.

- The Unit's scientific impact will be increased if submitted in relative journals of high impact; the wider impact in business, decision-makers and society will be facilitated by networking with relevant EU Institutes as EIT and its initiatives.

- Funded R&D should be transformed to innovation & entrepreneurship in collaboration to industry, start-up & spin-off companies on products and services should be more emphasized and direct social impact should be explored more analytically; the wider societal impact of the Unit beyond the Lithuanian energy sector should be more adequately considered in its future research and innovation endeavours with the positive influence on its development.

- The continuation and strengthening of the current research fields with directional competence improvement to global issues of energy transition and climate change and emphasizing topics as smart and carbon neutral cities and materials science for energy technologies will make LEI more attractive to PhD students and further advance the research groups; ethics, SDGs advancement and well-being (both internally and as outcomes) could be additionally integrated in the R&D subjects to improve social benefits.

- For further development and attracting new generation of researchers it may be useful to explore fundamental problems in the field of the Unit since the potential of fundamental and applied studies that may be conducted by the Unit is very high.

- PhD students are encouraged to defend their these within the four-year period and be able to apply for post-doctoral positions abroad for widening their research expertise and competence; it would be advisable to attract scientists and PhD students from EU (and may be non-EU) countries; increasing the number of

Ph.D. students can help promote the education of the next generation of scientists and enhance the Institute's research productivity and visibility.

- Dissertations, as open-access documents already available, would be advisable to be in English and include published papers in scientific journals with links in the English PhD summary at the repository; PhD students could be introduced in the knowledge exchange triangle during the doctoral studies through networking and participation in EIT-HEI initiatives; a framework on supporting PhDs along the pathway R&D&I&E in collaboration with the Research Technology Organization (RTO) and Santaka initiatives should be developed.

- Supporting budget for new researchers to organize their group could be included in the strategic plan of the unit to facilitate group's development.

- The gender dimension should be explicitly considered in the recruitment process while equal opportunities should be ensured in the organizational strategy.

- Challenged KPIs in accordance with national targets and similar to European as ERC grants and forefront competitive research funds could be also considered.

- More social media as twitter and EU channels could be used for Unit's results dissemination and results from EU funded projects (e.g., EnergyKeeper).



2.2. KTU_Mech-transp-energ Unit of Assessment

Name of the institution	Kaunas University of Technology
Official abbreviation of the name of the institution	KTU
Name of the Institution's unit of assessment (hereinafter – UoA)	Mechanics, Transport, Energy
Abbreviation of the UoA name	KTU_Mech-transp-energ
The scope of the UoA (FTE(SD))	45,19
Research area(s)	T 000 - Technology

Quality of the R&D activities by research fields (groups of research fields) of the UoA

Technology

Research field	Scope (FTE(SD))	Score (points)
T 009 - Mechanical Engineering	35,59	4

Reasoned justification of the score

Mechanical Engineering research in UoA combines engineering physics with materials science, to design, analyse, manufacture, and maintain mechanical systems.

Mechanical Engineering research field has the highest number of researchers and teachers compared to the other two in this UoA. Each research field has successfully run a doctoral studies program, but again this research field seems to have achieved the critical mass with (almost) a steady number of 25 theses conducted each year with an average of 4.6 theses defended each year (close to 20% - which indicates the thesis duration of 5 years). There is a fairly significant participation of foreign students among the doctoral students in this group, which can indicate a fairly important reputation of this doctoral program at the international level. This is certainly excellent. However, the Mechanical Engineering faculty should invest a significant effort to keep attracting the country's nationals to doctoral studies, since it is important for the further development of the Lithuanian economy.

The R&D activities are carried at high level in a broad field of Mechanical Engineering, with sufficient results to have reached international recognition. More specifically, the Mechanical Engineering research field activities concern the domains of micromechanical system engineering, piezo-mechanics and mechatronics, biomechanics, mechanics of materials and structures, processes and technology of manufacturing, vibroacoustic and design process digitization, including the prominent research directions related to material behaviour or dynamics. The quality of R&D activities is also confirmed by the publications in these domains, including a research monograph and papers in scientific journals with high impact factor (the component is also editing a low impact journal). The members of the research field are holders of US and EU patents, and several senior researchers have been recognized for the national awards. There are several European projects and other national projects that have resulted with an impressive budget for this research field.

The members of the research field have organized an international and several national meetings for senior and young researchers, as well as participate in international conferences abroad. However, even though the researchers present their findings at international conferences, not many are invited to give plenary or keynote lectures. Mostly, the level of participation and resulting dissemination is just average.

There are no outstanding research awards, which indicates that it would be difficult to pretend to highest level of funding (an ERC grant). However, the Mechanical Engineering team is doing an excellent job with industry.

Research field	Scope (FTE(SD))	Score (points)
T 006 - Energetics and Power Engineering	5,11	4

Reasoned justification of the score

Energetics and Power Engineering is a small Unit whose research is focused on heat transfer applications, biofuel combustion and flue gas removal, renewables for district heating, etc. The research used to be focused on niche applications in established technologies, but the scientists switched their R&D activities towards the indicated emerging technology fields just lately.

The Unit conducts doctoral studies (only full-time). The number of students is comparable year by year (PhD students from abroad are present), meaning that the Unit keeps attracting young researchers. Although most dissertations were written in Lithuanian, they slightly improved in quality and relevance over the years. However, an insufficient number of PhD students per professor limits the impact of the conducted research due to the lack of human resources needed to tackle the grand challenges of the field.

A relatively low number of researchers and professors, while the number of associate professors is excessive, giving limited opportunity for synergies. Most employed staff belongs to the group of associate professors (there should be more effort to engage also junior researchers). Female scientists are underrepresented. Staff internationalization is on a good way in terms of outgoing researchers and incoming students, but not yet developed in terms of incoming researchers. There was no information about research fellows from abroad.

Until recently, innovation was restricted to small market niches, but now it also aims at research topics with some commercialization potential. Very good publications have emerged as a result, but the impact of some articles published remains modest. Moreover, co-authorship with renowned international universities and research institutes is not yet common. Nonetheless, researchers of the research field collaborate both within KTU and abroad, which is very important for the recognition and networking support of the research field.

The researchers present their findings at international conferences, although not as invited or plenary talks. In general, the level of participation in such dissemination activities is average.

Only three awards are noted, and they are primarily of local importance. There is no outstanding excellence award among them, which would confirm the quality of the conducted research and development.

Good presence in grants, including domestic funding and initiatives supported by international sources such as Horizon program, ERDF, and EEE Baltic Research scheme.

Overall, besides the abovementioned weaknesses, the UoA is strong at the international level in a research field.

Research field	Scope (FTE(SD))	Score (points)
T 003 - Transport Engineering	4,49	3

Reasoned justification of the score

Transport Engineering research field is the smallest of three in this UoA. Research personnel include mainly researchers, while teaching personnel is limited to mainly supporting doctoral studies as was explained during experts group visit. The number of employees from the two categories with scientific degrees is low, but even lower in FTE. Given the low number of staff, mainly researchers, the opportunity for synergies is quite limited. It should be noticed that there is a good distribution between the different levels or professors/researchers and age distribution, giving a good opportunity for continuity. However, mostly have been educated at the same University and this ratio should be changed in the future to bring new ways of thinking. Staff internationalization is on a good track in terms of outgoing researchers and incoming students, but not yet sufficiently developed in terms of incoming researchers. There should be more effort to employ also junior researchers.

Main areas of research during the reported period include electric and autonomous vehicles, biofuels and energy policy. Just like other research fields, also this research field somewhat suffers from the fact that software engineering increasingly dominates RD&I in the field of transport, while a strong focus on software engineering has not been built up in this department in the past, and now it would be quite late. The switch in R&D towards newly emerged technologies has occurred just lately. Until recently, innovation was restricted to small market niches, but now it is also aiming in research topics with a higher commercialization potential. The team has developed the required relevant know-how and has found some new niches. However, these niches should be even more strictly focused on the future towards carbon neutrality.

The activities are mainly directed in applied research with publications in some high impact journals, well respected in the field according to the provided best results outcomes. However, the quality of journals in which the overall output was published still is not high enough; it was possible to publish a growing share of the research results in acknowledged scientific journals. Also, the share of publications in domestic journals is still high. Co-authorship with renowned international scientists is not yet very common. The list of the best reports delivered at conferences shows an adequate scientific communication of R&D research results on the field with presentations mainly in biofuels, but not plenary or keynotes.

National awards have been given to the members of this research field and connected also to students' performance. However, the number of awards achieved is quite low, the awards were achieved only at national level, and there is no outstanding excellence award among them.

The best outcomes details of the participation in the competition-based R&D projects include research funding from National sources (Research Council of Lithuania and Defence Studies) and some international ones. Most of them are national funded projects. The total number of projects funded is low compared to the number of people (if all projects are listed in the report). Also, there is quite low coherence between the different projects. Any international coordination is not emphasized.

Starting from zero in 2019, there is a slight yearly increase in the still small number of PhD students and also in the number of foreign PhD students. Doctoral theses are good in quality and relevance. However, the total number of PhD students and per professor is still low. Most of the students complete a part of their studies or research at foreign research and educational institutions. The extended duration of doctoral studies has a negative impact on competitiveness and novelty of outcomes.

Overall, the UoA is strong with limited international recognition in the research field of Transport Engineering.

Economic and social impact of R&D activities of the UoA

Score (points)

4

Reasoned justification of the score

The UoA carries out very important scientific research and is a very important partner in R&D beyond the academic community. The research conducted at UoA impacts the socio-economic environment in many diverse fields of life. For example, in services to economic entities, UoA has provided a high number of solutions such as the recycling of banknotes, the development of an intelligent hockey training system, a prosthetic socket, the design and research of an experimental rocket, a self-service cash checkout, etc. The sheer number of implementations is impressive, especially since some of the developed solutions can be readily used outside Lithuania. Hence, it can be concluded that the R&D carried out by the Unit is of high practical importance. Moreover, national smart specialization strategy was taken up by the UoA comprehensively.

In essence, the economic impact has started improving as the ties to the domestic and international industrial sectors have got closer recently. However, still, the UoA does not seem to be an integrated part of the industries' innovation plans. The chosen thematic focus seems to reflect the needs of the domestic industries quite well. The number of spin-offs is far below the potential.

The documentation includes evidence of the participation of Unit's researchers in working groups and commissions - mainly in national ones with low involvement in international ones. Nonetheless, the described roles are essential. Moreover, the number and character of consultation works are rather good. It should be appreciated that these activities are clearly explained, and, in many cases, the outlook and plans are sufficiently described. However, based on the provided research portfolio, it can be noted that this high level of engagement outside academia occurs at the expense of the core research activities.

Several dissemination activities were described, some of which have an international nature, which is good. While the researchers commonly engage in serving as guest editors/board members/etc., the selected journals are usually of relatively low impact. In terms of membership in international working groups and associations, the presence in such organizations is at a sufficient level (some international entities such as NATO or the Royal Swedish Academy of Engineering Sciences were also mentioned, indicating worldwide recognition of certain KTU scientists).

The UoA adequately considers the need to popularize the research results by organizing domestic or international conferences. The documentation includes evidence of sharing generated knowledge also with non-experts. Lastly, the UoA actively cooperates with universities, research institutes, companies, and decision-makers. The contributions of each party and exploitation plans are cogent.

The development potential of R&D activities of the UoA

Score (points)

4

Reasoned justification of the score

The UoA has potential to achieve very good ratings. The UoA is in possession of the infrastructure necessary to maintain the current level of output, with the possibility of extending it further. The available instruments correspond well with the aims and aspirations. R&D infrastructure is open to internal users and as services for external users. Additionally, KTU members have direct access to national and international equipment through participation in various alliances and associations. Analogously, KTU actively engages in many international organizations and associations, which increase the internationalization degree by promoting the exchange of knowledge and staff. Consequently, this gradually makes the UoA more visible in European science.

It should be noted that the structure and dynamics of human resources are very reasonable. Although most employees are between 35-54 years old, there is a large group of early-stage researchers (25-34 years old) who are the future of KTU. This UoA has achieved a critical mass for keeping with scientific R&D activities at the highest national level, with the strongest component and some members reaching international recognition as well. While women are underrepresented, KTU put in place Gender Equality Plan 2022-2025 in 2021, which should gradually change this situation.

Moreover, human resources management principles very convincingly explain the procedures engaged by the university to recruit and promote staff. Importantly, a broad spectrum of measures ensures the appropriate development of a new generation of researchers. Special efforts are employed to attract and retain the best researchers in a friendly working environment while basic KTU principles on academic freedom, responsibility, ethics, academic integrity, and loyalty are also applied. A place for further improvement would be the strategy for inciting the UoA members to launch interdisciplinary R&D activities, which could also be quite crucial for future growth and development.

A highlight of the application is a comprehensive action plan regarding research and innovation development for the upcoming future, quantitatively specifying the expected outcomes. Likewise, the description and justification of the R&D themes to be developed by the UoA are exciting and reasonable. On the other hand, this plan covers numerous research domains, which seems somewhat ambitious, even for a very large UoA. Moreover, there is insufficient information about plans for grant applications that can fund such efforts.

Finally, the given SWOT analysis is thorough, credibly representing the strengths, weaknesses, opportunities, and threats of UoA. Still, it should be mentioned that the majority of the presented weaknesses relate to the Lithuanian scientific environment. A closer look at the weaknesses of the UoA would have increased the ability to improve the strategy.

Recommendations for continuity and/or improvement of the activities of the UoA

The Panel recognizes the efforts of the UoA taken in the current evaluation period. Clear improvement in many areas is evident, which increased the recognition of the UoA nationally and internationally. Thus, the UoA is overall positively assessed. Nevertheless, there are still aspects that require more attention from the UoA to become widely recognized abroad. Please take into account the suggestions provided below, which can eliminate the barriers limiting the potential of the UoA:

1. Publications – while several publications are listed in good journals, their number is rather low with respect to the size of the Unit. Publishing in leading journals should become the priority if the UoA aims to be a research institution able to attract the best researchers for collaboration or even visiting professorship.
 2. Human resources – to obtain a critical mass of research results expected in the most competitive scientific journals, considerable effort is required. However, the number of PhD students per professor/chief researcher is relatively low, so the research groups are focused on less thorough studies, considerably minimizing the possibilities for breakthrough discoveries. Consequently, these results are typically published in low-quality journals. More young scientists should be attracted to drive the development necessary for producing papers that can really make an impact.
 3. Projects – the number of projects funded from external sources increased in the evaluation period, which is a good outcome. However, if one considers the size of the UoA, it is desirable more researchers should lead projects or participate in them. For that to happen, more attention should be devoted to carrying out research rather than providing many consulting works. More assistance should be provided to the researchers to enable them to compete in EU and ERC grant calls.
 4. Internationalization – although the UoA has made some improvements in this area over the past few years, the number of scientists with international experience is still insufficient. At the same time, it is challenging for the researchers to go abroad from Lithuania for a longer time to gain unique know-how. These aspects should be improved to improve the quality of R&D carried out in the UoA.
 5. Commercialization – the UoA elaborated a number of valuable solutions that can be potentially implemented by the industrial sector to improve the quality of life in the long term. Unfortunately, at present, there is not enough effort to commercialize them. There should be more activity in terms of start-up formation to facilitate the technology transfer from the lab to the environment outside academia.
 6. Synergies – it would be reasonable for the UoA to increase its synergies and collaborate closely with each other.
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2.3. KTU_Statyba Unit of Assessment

Name of the institution	Kaunas University of Technology
Official abbreviation of the name of the institution	KTU
Name of the Institution's unit of assessment (hereinafter – UoA)	Civil Engineering
Abbreviation of the UoA name	KTU_Statyba
The scope of the UoA (FTE(SD))	26,40
Research area(s)	T 000 - Technology

Quality of the R&D activities by research fields (groups of research fields) of the UoA

Technology

Research field	Scope (FTE(SD))	Score (points)
T 002 - Civil Engineering	26,40	3,5

Reasoned justification of the score

The UoA conducts research within a wide range of 'Civil Engineering' related fields. All belonging to Civil Engineering. The research topics are all relevant. They are useful for the Lithuanian society, and they are in line with international trends. Especially when it comes to energy savings in buildings.

The quality of the R&D is of high level. The R&D is nationally very well recognized with some international recognition. The UoA has improved the quality of the R&D over last several years, and most suggestions from previous evaluation have been implemented. The Civil Engineering unit includes faculty members with an established and significant research track record.

There is a good integration into the European research community achieved via cooperation in European projects such as Horizon, COST, Erasmus and ECIU, but Erasmus staff mobility cooperation could be deeper. The importance of the EU-oriented activities is more related to cooperation issues rather than financial issues.

The research staff actively participates in recognized local and worldwide international conferences of good impact (under the auspices of recognized organizations like RILEM or IEEE), in most cases with indexed publications.

The UoA publish in recognized international journals. The number of high-ranking publications is modest, but the number of CA WoS articles published in 2018-2022 has doubled when compared to the (low number of the) baseline of the previous period, and now there is a reasonable number of CA WoS indexed publications. Most publications have many co-authorships, which indicates good multidisciplinary cooperation on national as well as international level. Although the summary report indicates that all papers are published in top-ranked journals, a closer examination of the CVs of the faculty members reveals a significant number of publications in lower ranked journals.

Few patents were reported.

KTU is the second largest university in Lithuania, when it comes to number of PhD students. Still, the number of PhD students at KTU - Civil Engineering is low.

There was an award for the best Building Information Management (BIM) project of the year; the other awards granted are valuable but do not give evidence of actual excellence.

Laboratory equipment is extensive. Still a higher state investment into modern laboratory equipment would be beneficial.

The UoA is aware of this need to increase staff mobility in both directions, and apparently has a problem with teachers reluctant to go abroad for longer periods. English language barriers seem to exist among older teaching staff. There are efforts to reduce non-research workload of research staff and allow them to focus more on R&D&I, which is valuable. Organizational reforms replacing departments by more open and flexible research groups seem to have been successful; synergies can be expected.

The UoA comprises two university units, namely the Institute of Architecture and Construction (focusing on research and services for the industry) and the faculty of Civil Engineering and Architecture (focusing on research-based education). The two units are located on different addresses. Both units have a good performance, but due to the separation there is a lack of coherence in the work/research carried out by the two units.

Overall, the Civil Engineering unit demonstrates strong research capabilities, but its international recognition is limited. The R&D carried out is of a high standard and has garnered national recognition.

Economic and social impact of R&D activities of the UoA

Score (points)

3,5

Reasoned justification of the score

The UoA carries out important research for the society and is an important partner in R&D outside the academic community. All the topics of the R&D activities are very relevant for the Lithuanian society and the building industry.

The UoA actively engages in collaborations with economic entities through various projects and consultations, and its members hold leadership positions in local associations such as the Lithuanian Association of Civil Engineering. The members of the UoA also organize conferences and participate in editorial boards, in some cases in prestigious journals in their field of expertise. The Unit's limited participation in international working groups and associations may impact its international reputation. Furthermore, the Unit is dedicated to science popularization and has signed multiple cooperation agreements with economic entities. Its R&D infrastructure is well-equipped and includes state-of-the-art research centres.

The economic impact of the UoA's recent activities certainly have come to a point of reaching the expert community and discuss findings there. Nevertheless, the activities almost never seem to have crossed the bridge to commercialization neither been really convincing for the national political sector of practical measures. As many projects were implemented in teams at European scale, one might find some impact at EU level, but this was not seen. Most of the recent R&D projects have remained without commercial uptake;

at least there was no such mentioning. Hence, the UoA so far has been just moderately successful in the effort to improve and develop meaningful new products and processes.

Societal and environmental impact can be found in work oriented towards greening and smart city approaches; but only indirect traces of impact on social wellbeing can be found. Conclusions about practical benefit potentials of created innovations are missing, and it seems that most research outcomes have been limited to the quantification of results and stating of technical feasibility without attached research on use cases and commercialization potentials.

The UoA is well represented in popular media. BIM is a topic that raises public attention – this fact was made good use of in efforts to present BIM and digital twins of buildings and settlements to a wide audience by popular media.

Scientific popularization activities are on an excellent level. Several topics presented to the public were reported. These topics were related to current scientific activity of UoA researchers, e.g., trends in the construction industry, smart cities and digital twins, BIM, indoor environment and risk of cross-infection, energy efficiency and renewable energy sources integration in the building stock, innovation in building materials research, etc. There were several articles and interviews with UoA employees on the internet, YouTube, and internet videos, and appearance on national TV news.

Overall, the Unit plays a crucial role in scientific research that is relevant to society and maintains strong partnerships with academic, industry, and governmental entities.

The development potential of R&D activities of the UoA

Score (points)

3,5

Reasoned justification of the score

The topics of the R&D activities are very well suited for the times we are living in. The energy consumption in buildings is almost 40% of the total energy consumption, so when the UoA focus on sustainable houses it is very relevant and with high potential.

The UoA concentrates on R&D activities towards supporting smart specialization of the construction sector, which also aligns with the KTU strategy. These activities are based on different sources and strategies (e.g., national, EU, UN, European Consortium of Innovative Universities). The research priorities of the UoA are: energy and sustainability (research towards sustainable, energy-efficient, and healthy buildings), smart and circular economy (reduce the ecological footprint of the building sector), digitalization and construction 4.0, and resilient communities and infrastructure. In these areas, UoA has appropriate competencies and resources formed around the topics of sustainable energy in the building environment, as well as building materials, structures, and technologies. These UoA research priorities have very good perspectives nationally and internationally, and UoA has a good background based on previous studies and cooperations. This was credibly justified.

Basically, there is a good potential for a Civil engineering Unit on the regional science market, but only under the conditions that it addresses customers and research partners beyond national borders and that it puts a distinct focus on emerging research topics. The UoA has committed to the content of smart specialization and a circular economy, but its plans to implement that commitment cannot yet fully convince. There is much effort on a stronger recycling aspect of construction materials, which still reflects greening strategies of the

2010s. Research on improvement to the existing building stock is not widely enough applied, and the UoA's circular economy approaches build too heavily on downcycling. Research goals lack ambition when assessed regarding transformation necessity.

Start-ups are being supported, but the small number of startups founded suggests that more needs-driven support should be offered.

The SWOT analysis of the UoA was carried out thoroughly, looking not only at internally caused weaknesses and external threats but also at those specific for the Unit, which is a good basis for strategic planning.

The SWOT analysis of the UoA is mostly accurate. The UoA sees its strengths, opportunities, and threats. But some weaknesses are missing. These are mostly related to UoA activity, e.g., low number of national projects, low number of patents, few postdocs, few research fellows from abroad, weak impacts of results of collaborations with the industry, low number of significant awards of UoA representatives, insufficient number of research outcomes with clear and significant socio-economic impacts, low number of conferences and events organized, low number of memberships of researchers representing the UoA in international working groups, associations, organizations, no cooperation agreements with national and international scientific and educational organizations and economic entities, including well-known organizations, and insufficient representation in editorial boards of recognized journals.

The fact that industries are increasingly investing into own lab capacities is discussed under the headline of threats whilst it could be seen as an opportunity. The University's labs should not specialize in testing which can also be done as commercial services (which would bind capacities needed for continuous progress) but should act where the ability of commercial labs ends; commercial labs can be cooperation partners and a productive driving force.

Staff from the UoA seems committed to research. There is a commitment to do a 'good job' and a willingness to cooperate and network on a national level as well as an international level. The high share of part-time staff working also in private companies was seen as a problem in the SWOT analysis but could also be seen to allow mutual filtering of knowledge and awareness if properly tapped.

The UoA has a good and thoughtful strategic operating plan. The mission of the UoA is to conduct internationally recognized research and studies, contribute to achieving sustainable development goals for the country and the region, and train highly qualified professionals. UoA activity is in line with the implementation of a smart specialization strategy in the country. UoA Strategy for Research and Innovation outlines key directions for advancing research and innovation. It is oriented toward enhancing research outcomes (by improving the number of scientific publications, international patent applications, and research grants) and strengthening the international profile and visibility. This will be achieved by investing in the scientific staff, improving research management, and strengthening collaboration (e.g., by better utilizing research networks in which UoA participates). Key strategic priorities for the next 5 years for UoA are: to attract research projects and efficiently manage them, to increase collaboration within networks and increase UoA visibility, and to develop a research and innovation ecosystem.

The UoA has a low number of PhD students and especially a low number of foreign PhD students, which indicates staff problems in the future. A policy for the training of the new generation of researchers" is in operation, and several options for PhD studies are implemented.

Overall, the Unit is well-positioned to maintain its sufficiently good ratings in the next five years due to its strong human resources, strategic planning, well-organized activities, and good infrastructure, all of which support its continued high performance.

Recommendations for continuity and/or improvement of the activities of the UoA

The Panel recognizes the efforts of the UoA taken in the current evaluation period. Clear improvement in many areas is evident, which increased the recognition of the UoA nationally and internationally. Thus, the UoA is in general well-functioning and should continue the development track it has followed the last years. The following recommendations are suggestions for further strengthening of the Unit:

- The knowledge developed through research at the UoA should be better transferred/implemented in the development of wealth and well-being in the society. The Unit should create closer links to industry.
- The balance between fundamental and applied research should be shifted towards more basic research. The UoA should continue the trend with more publications in high impact and highly cited journals.
- The number of PhD students should be increased. While today most PhD studies take 5 years to complete the Panel strongly recommend to encourage shorten the studies and complete PhD projects in 4 years.
- The UoA comprises two university units, namely the Institute of Architecture and Construction (focusing on research and services for the industry) and the faculty of Civil Engineering and Architecture (focusing on research-based education). The two units are located at different addresses. The Institute of Architecture and Construction is in some old buildings some kilometres away from the campus. The institute should be moved to campus to increase the synergy between activities at the two units.

2.4. VilniusTech_EE Unit of Assessment

Name of the institution	Vilnius Gediminas technical university
Official abbreviation of the name of the institution	VILNIUS TECH
Name of the Institution's unit of assessment (hereinafter – UoA)	Environmental Engineering
Abbreviation of the UoA name	VilniusTech_EE
The scope of the UoA (FTE(SD))	25,99
Research area(s)	T 000 - Technology

Quality of the R&D activities by research fields (groups of research fields) of the UoA

Technology

Research field	Scope (FTE(SD))	Score (points)
T 004 - Environmental Engineering	11,92	3,5

Reasoned justification of the score

Environmental Engineering research in UoA is mainly focused on treatment and recycling of wastes, remote analysis of air pollutants, particulates separation and biofiltration systems.

Regarding the employee group structure in the Unit, it is predominantly composed of associate professors performing teaching duties and chief researchers. The number of researchers and professors is quite equilibrated. The lack of assistants and fellows (especially from abroad) is a disadvantage. Researchers are mainly chief, senior and researchers with low FTE while teaching personnel of professors and associated is limited in supporting doctoral studies in addition to research and other duties. Generally, there is a quite low number of researchers and professors, giving low opportunity for synergies, and relatively low percentage of lowest degrees, resulting difficulty for continuity. Moreover, there is a low FTE. It should be noticed that most of the researchers/professors have been educated (at least at the 3rd level) at the same Institute. It is suggested to try to hire personnel educated from other Institutions.

This research field has doctoral studies. Subjects of PhD projects are mainly covering adsorption, immobilization of toxic elements and removal of gases, biogas production and purification, use of Unmanned Aerial Vehicles (UAVs) for monitoring, sound absorber and are of high quality and practical value with a potential impact in Lithuania. The number of students was varying for the last five years, starting with the highest number of students in 2018 (including foreigners) and reducing steadily in 2021, and picking up again in 2022. Thus, the main condition to ensure a certain level of vigorous research activities - having doctoral students - seems to be fulfilled. All the students are financially supported, encouraged to write the dissertations in English and publish articles in CA WoS indexed journals of higher impact. However, there is a quite low number of PhD students per professor and quite high change over the years. A higher and more constant number of students (locals and international ones) is necessary. Also, a low number of the defended PhD theses were written in English. It is recommended to expand the research topics of the dissertations in

other topics of the field as circular economy and sustainability, increase the gender balance by attracting more female students as well.

The list of the best research outputs in the last five years covers several domains of Environmental Engineering, from waste management to air pollution. Best research outputs cover a monograph and journals of high impact factor. A European patent was also submitted in best articles but was published in 2015. The list of the best reports delivered at conferences abroad is quite low and no invited plenary or keynotes are mentioned. Although several awards were received for the research activity, these are mostly of national impact. Overall, there is a rather balanced mixture of the results in more fundamental research and applied research that the members of this component and their doctoral students have contributed. However, taking into account the available human resources, the overall outcomes are below expectations.

The level of participation in projects funded by external sources is average – most of the projects were obtained from national sources (Research Council of Lithuania). The number of projects funded is low compared to the number of people. The coherence between the different projects seems to be quite low.

Overall, the Unit is strong with limited international recognition in the research field of Environmental Engineering. R&D carried out is of a high level and nationally recognized. Generally, the effort is quite good, it should be continued.

Group of research fields within the research area	Scope (FTE(SD))	Score (points)
T 005 - Chemical Engineering	14,07	3
T 010 - Measurement Engineering		
T 006 - Energetics and Power Engineering		

Reasoned justification of the score

The group of the research fields of this UoA represents Chemical Engineering, Measurement Engineering, and Energetics and Power Engineering. Research in the group included chemical (e.g., biological concrete and basic studies), measurement (e.g., positioning and remote sensing) and energetics and power engineering (e.g., ventilation). These three domains do not seem to have been (formally) collaborating before, and in any case, did not have a joint doctoral studies program. Therefore, their level of activities (especially joint activities) is not very strong. Yet, each of these domains provide its contribution on R&D activities output, with a sum that is quite heterogeneous. The reason for that is in the fact that contributions come from 3 different departments (Chemistry, Building Energy and Geodesy) and 1 institute (Geodesy).

Personnel of the UoA includes a moderate number of researchers and teaching staff, with some other employees related to R&D. Researchers are mainly chief, senior and researchers, while teaching personnel of professors and associated is limited in supporting the three research fields of the group. The number of people from the two categories with scientific degrees can be characterized as moderate, but it is quite low in FTE. This quite low number gives low opportunity for synergies. Also, there is a relatively low percentage of lowest degrees, resulting in difficulty for a continuity of the activities. Another weakness is the absence of fellows (particularly of international origin) and assistants.

The UoA does not carry out doctoral studies in the research fields of Chemical Engineering, Measurement Engineering, and Energetics and Power Engineering.

Researchers bring considerable scientific experience and competence in groups of fields with adequate publications in scientific journals. The list of publications includes articles in good to very good journals, such as *Angewandte Chemie* (corresponding authorship is noted). However, the scientific level of the best of publications is expected to be higher taken into consideration the number of scientific staff. Moreover, the

researchers presented their results at a certain number of international conferences abroad, although not one was invited or gave a keynote talk. European patent application is appreciated.

The number of awards is relatively long, which is good, but the impact of most of them does not extend beyond Lithuania. A notable exception is the award of internship at NASA for one of the students, but it is uncertain whether it fits the criteria “The term "awards" is understood as awards for a merit (e.g.: prizes, honorary titles, medals, orders, etc.) – not competition-based R&D projects.”

The same is also evident in the research funding which is mainly from national resources without EU competitive funds on R&D. It seems that there is low coherence between the different projects.

Overall, the UoA is quite strong with limited international recognition Unit shows a R&D carried out is of a high level and nationally recognized. Generally, quite good effort, it should be continued.

Economic and social impact of R&D activities of the UoA

Score (points)

3

Reasoned justification of the score

This UoA is a result of the merge of the activities in the domain of Environmental Engineering with a group of three domains concerning Chemical Engineering, Measurement Engineering and Energetics and Power Engineering. The list of research outputs, R&D orders of economic entities, and projects is moderated but diversified. Different important fields were included in the agenda, perfectly aligned with ODS and with a considerable economic and social impact.

During the reported period, this UoA has been active in services for national authorities as the Ministry of Agriculture and Culture Council, building constructors, wastewater management authorities, there are reported cooperations on noise barriers using rubber waste, carotenoids synthesis, air analysis of Vilnius, waste stabilization, and participation in Erasmus network. The research carried out is important for the society. However, this must not be at the expense of the core of research activities.

No start-up & spin-off companies on products and services are evident and direct social impact could be described more analytically.

The list of the main consultations provided is extensive and in different subjects with impact and fundamental to the public and economic entities: agencies, municipalities and regions on waste management, environmental monitoring, sound management and indoor conditions, biogas production, seminars on environmental topics, geodetic measuring devices, thermal bridges, heat supply system, protein investigation, microorganisms growing in the hemp field. However, a balance is necessary between consultations and research activities.

The participation of researchers from the UoA in working groups and expert commissions is evident. It is appreciated that some of them are at the highest national level. Nonetheless, it would be beneficial to include more contributions to committees working outside of the country, which is low.

Adequate organization of conferences during the reported period with some international (Geo-Information Science, Environmental Engineering, Biophysics, Biochemical), national and conferences for young scientists.

However, these are mostly of average international recognition. Also, other types of events, including seminars have been organized.

Researchers of the UoA have been members of editorial boards of one international journal, several national (Lithuania and other countries) and guest editors for journals. However, these are mostly low-impact journals of average international recognition.

Significant memberships of the UoA researchers in this category include member on the EU Mission Assembly for Climate-Neutral and Smart Cities, EISN-INSTITUTE, AGILE, Nordic Geodetic Commission Covenant of Mayors – Europe, International Waste Working Group, Municipal Waste Europe, COST and expert activities for ERC and H2020 programs and as national representatives in ISPRS.

Extensive science popularization activities in news media, LT TV and radio programs, press releases, portals, Science popularization project "I don't waste energy", popular science journal; recommendation to use social networks as well. Other strategies to reach especially the younger population can also be considered in the future, including podcasts, and social media. It should be noted that these activities must not be a barrier or at the expense of other academic activities.

There are extensive cooperation agreements with institutions such as Lithuanian Research Centre for Agriculture and Forestry, Environmental Protection Agency, Centre for Innovative Medicine. Vilnius Tech is a member of the Advanced Technology Higher Education Network Alliance – the ATHENA European University, there are bilateral agreements with Institutes from Indonesia and Ukraine, cooperation agreements with companies, and other Lithuanian institutions.

However, foreign collaborations are limited and international collaborations with neighbouring countries and even other European countries are almost inexistent. Unfortunately, the long-term impact of these forms of collaboration is unclear and there is no indication on how this number is translated to projects and research collaborations.

There is quite good R&D infrastructure, however not enough “heavy” equipment.

The UoA carries out important research and is an important partner in R&D outside the academic community.

The development potential of R&D activities of the UoA

Score (points)

3,5

Reasoned justification of the score

The focus of this composite UoA is rather heterogeneous. Environmental Engineering proposes focusing upon the topics such as: air quality researches, modelling of pollutants dispersion and development of air treatment technologies; water quality researches, modelling of pollution and development of water treatment technologies; hydrological researches of open rivers greats and evaluation of hydrotechnical structures; noise researches, modelling of the dispersion in the environment and development of the technological solution for the noise minimization. Chemical Engineering proposes focusing mainly upon research on cells and their biologically active components. Finally, Energetics and Power Engineering and Measurement Engineering propose to focus on sustainable building, one from standpoint of modelling and experiments and the other from standpoint of geoinformation technologies.

The sum of the proposed activities reflects well the primary focus of each of this UoA components. What is missing is a more convincing attempt to merge some of these activities into 'more than a sum' and to achieve

the synergy of the skills. This is probably the consequence of the fact that most of the researchers are in the age bracket 40-50 years, where they are likely to have their own field of research that is not so easy to change. Hiring some younger researchers would probably be the most efficient way to achieve such synergy, but this should be first rediscussed at the level of UoA to fix clearly the priorities.

R&D infrastructure: It is well developed in the UoA with research equipment, software and access to databases. The R&D infrastructure of the Research Institute of Environmental Protection, Institute of Geodesy and the Departments of Environmental Protection and Water Engineering, Chemistry and Bioengineering are used which are well-equipped and appropriate for the scientific research of the members of the UoA. Available equipment is also significant for research in the field of Energetics and Power Engineering. Additional infrastructure for researchers is available through the extended networks in national R&D infrastructure and international alliances and European associations. Vilnius Tech initiated the transition to a net zero campus and improved the establishment of all players in the knowledge triangle exchange. However, the “heavy” equipment is not available, limiting the research outcomes.

Human resources: More than one hundred research workers, professors with scientific degrees, and other employees and doctoral students related to R&D and studies are present in the UoA.

There is an unbalanced personnel number among researchers and other employees and PhD students; this needs particular attention from the UoA for improving the R&D&I support. The age distribution of scientists in UoA is appropriate with a centroid at a very productive R&D period (35-44), while the number of 25-34 years old is limited. Therefore, maintaining the current level of scientific activity in the future may be challenging. Gender distribution is balanced and very important to be sustained.

In terms of current human resources within the different groups, the UoA has almost perfect equilibrium. Namely, with roughly 1/3 from Environmental Engineering, a bit less from Chemical Engineering and the remaining ones from split between Measurements and Energetics & Power Engineering. Nonetheless, this still remains a rather unusual mix in a single UoA, which should be further elaborated upon with clearer guidelines on how to achieve better synergy and fix the corresponding priorities. The division into specific groups of research within each research field seems to not exist and the number of junior researchers is extremely scarce, and the majority of the staff are associate professors. No assistants exist and the number of lecturers is very small. It is important to ensure that there is no exclusion or artificial barriers of a part of scientific/research staff to their research and their other activities. It is important to ensure that the lower levels of scientific/research staff have the necessary academic freedom and independence of the higher levels of scientific/research staff to carry out their research and their other activities.

Management principles on recruitment are properly based on open competition under the principle that all procedures are transparent, non-discriminatory, and inclusive. Academic staff are being offered opportunities to improve their pedagogical and research competencies.

All the PhD students are full-time and no students exist at part-time. The number of PhD students is extremely low and is decreasing. That should be taken into account within the strategic plan, with a clear indication on how to handle future growth. Namely, the specialized courses for doctoral students, which allow to provide them with the possible transfer of knowledge and the guarantee to reach the goal of completing their theses in a limited period of time, should be considered in terms of combining resources of each component to reach critical mass.

UoA follows the Vilnius Tech policy on excellence in technological research for next-generation researchers. In this context, the Unit is working on strengthening students' capacities with several actions from the very beginning of school years up to research projects participation and internationalization through programs as Erasmus, ATHENA alliance and Internships. However, more attention should be given to the introduction of

students in the knowledge exchange triangle through networking and participation in EU initiatives (as EIT-HEI) and extend the path of R&D&I to entrepreneurship. UoA's SWOT analysis in the self-assessment report has revealed weaknesses in this field which are also extended on doctoral studies and students' enrolment. PhD program and attraction of PhD students should be considered further at the core of Unit's recruitment plans. Improving the students career prospects through local R&D&I&E ecosystem development, national & European socialization and internationalization could be highly supportive for improving the overall R&D conditions of the UoA.

Output and funding: The list of best research outputs includes medium/high impact factor publications. Some reports were delivered at international conferences, the majority in European countries. A medium number of national awards were attributed, and include the best dissertation thesis, best research paper, and also best presentation award.

The details provided of the participation in the competition-based R&D projects were considered of a high merit with the involvement of collaborations with other research groups, including international collaborations. However, this should be enhanced.

The strategic operating plan: The strategic objectives of the Unit are well established with applied engineering and technology-based activities at the forefront of research and sustainable development on the field of Environmental, Chemical, Measurement, Energetics and Power Engineering. Capacity building, seeking for excellence, increasing impact, and expanding collaboration are mid-term strategic aims of the UoA with a strong link with the strategic plan of Vilnius Tech University. It is recommended to reorganize the strategic plan of the UoA with specific KPIs achievement every 3 years in R&D&I and doctoral studies under a certified Quality Management System, including challenged KPIs in accordance with national and EU targets.

R&D subjects to be developed: UoA plans to strengthen its research fields with directional competence improvement to global issues of energy transition and climate change. Current research fields that are closely related to the priority tasks of EU, such as climate change, circular economy, efficient use of resources, security of energy supply, public health, healthy food, etc., will continue to be developed with further emphasis on circular economy, waste remediation, cleaner production, sewage sludge treatment technologies, hydrological studies, climate change adaptation and mitigation, air pollution, healthy food, biosensors and fuel cells, recycling, energy efficiency and indoor climate, renewable energy technologies in buildings, digital twins, GIS and urban planning. However, this envisioned expansion requires a considerable increase of the available FTE(SD) and doctoral studies in all the submitted fields.

SWOT analysis: Self-assessment has revealed the strengths, weaknesses, opportunities and threats of the UOA. The SWOT analysis is fair and comprehensive.

The UoA has the potential to achieve good to very good ratings in the next 5 years.

Recommendations for continuity and/or improvement of the activities of the UoA

Generally, the Panel recognizes the significant efforts provided from the two units. Overall, the UoA is positively assessed. However, more effort is necessary to reach international standards.

A clearer “identity” of the different research groups should be defined. More synergies between the research groups should be developed. More efforts should be made to develop interdisciplinary topics. The sustainability should be included in all research topics.

A higher effort to increase internationalization should be applied. Internationalization should be enhanced in all aspects: people, mobility, publications, conferences, funding, etc.

Resources: the number of people is quite adequate, but it is recommended to increase it. More young researchers and technicians should be enrolled to assure continuity. More people who have studied in other Institutions should be enrolled. More PhD students should be enrolled. More synergies should be created. The duration of PhD should be decreased to four or even three years. PhD students should be full time students and not work for the industry during their PhD.

Equipment: More “heavy” equipment is necessary to achieve research outcomes of the international level.

Output: The number of publications in scientific journals, the presentations in conferences, the plenary lectures etc should be enhanced, especially in the international level and high-ranking journals.

Projects: The number of projects, especially from international funding institutions, should be increased. Proposals at the level of ERC Starting Grant or ERC Consolidation Grant should be submitted and be winning.

Consultations, science popularization activities: The number is high. However, this high number is at the expense of the core of research activities. Moreover, the long-term impact of these forms of collaboration is unclear. It is recommended to focus only on some core activities and clarify their impact on the UoA. Moreover, it would be beneficial to participate in committees working outside of the country.

Cooperation agreements: There is a high number of agreements. However, there is no indication on how this number is translated into projects and research collaborations. It is recommended to enhance the content of each agreement.

2.5. VilniusTech_CE Unit of Assessment

Name of the institution	Vilnius Gediminas technical university
Official abbreviation of the name of the institution	VILNIUS TECH
Name of the Institution's unit of assessment (hereinafter – UoA)	Civil Engineering
Abbreviation of the UoA name	VilniusTech_CE
The scope of the UoA (FTE(SD))	71,00
Research area(s)	T 000 - Technology

Quality of the R&D activities by research fields (groups of research fields) of the UoA

Technology

Research field	Scope (FTE(SD))	Score (points)
T 002 - Civil Engineering	40,44	4

Reasoned justification of the score

The Unit boasts a highly accomplished faculty, comprising distinguished scholars and experts with extensive experience in the field. Although the Civil Engineering Unit has a respectable publication record, there is room for improvement in terms of publication impact and international recognition. A considerable portion of their publications, other than the ones included in the self-assessment report, is in mid-tier journals, which may not have the same prestige and impact as top-ranked journals. This trend could potentially undermine the Unit's research efforts and reduce its international impact. The relatively moderate number of citations Unit (according to Scopus and excluding a small number of highly cited researchers) received by the Unit reinforces that its research outputs may not have had a significant impact or influence in the field. On the other hand, the Unit has many papers that include international collaboration with well-known universities and research institutions, indicating a willingness to work with other researchers and provide a global perspective to their research outcomes. The research staff actively participated in well-recognized local and international conferences, in most cases with indexed publications. Despite the relatively low number of PhD students who graduated from a Unit with five departments, three institutes, and three laboratories, most of the dissertations focus on applied research, highlighting a practical approach to solving real-world problems. The Unit needs to expand its research portfolio to include more basic research topics. By diversifying its research efforts and exploring new avenues of inquiry, the Unit can further enhance its reputation for innovative and impactful research and contribute to the advancement of the field as a whole. There are no patents reported as the best research results in the self-assessment report. It seems that the Civil Engineering research field has faced challenges in securing competitive national and international research funding; however, its faculty members have shown exceptional resourcefulness and dedication to their work, as evidenced by the numerous research awards they have earned, including two best PhD thesis awards issued by the president of Lithuania, two best national scientist awards, a Web of Science highly cited researcher, and a world innovation in bridge engineering prize. The Unit's ability to thrive with limited

resources is a testament to the ingenuity and determination of its faculty, who have consistently delivered innovative and impactful research. The QS ranking is one of the most widely recognized university rankings globally and being included in the ranking can signal that the Unit is reputable and of high-quality. According to the QS ranking, the Civil Engineering unit's civil and structural engineering and architecture and built environment ranking dropped between 2019 and 2022. While rankings are not always a perfect reflection of quality or achievements, they can serve as a useful indicator of the international reputation and standing of the research field. Overall, the Civil Engineering Unit is strong internationally and has a solid foundation for conducting internationally impactful research and advancing the field.

Research field	Scope (FTE(SD))	Score (points)
T 008 - Materials Engineering	30,56	3,5

Reasoned justification of the score

The Material Engineering Unit is home to a faculty with a respectable track record of research accomplishments. While the faculty of the Material Engineering research field has a decent publication record in recognized journals, it is worth noting that many of their papers are published in regional and lower-tier journals. This is not necessarily indicative of the quality of their research. However, it limits the impact and visibility of their work within the international academic community which is depicted in the relatively moderate number of citations. This may suggest a need for the Unit to enhance the quality and relevance of its research outputs, as well as collaborate more with other institutions to increase its impact and influence. International research collaboration with faculty from well-known universities and research institutions will help to improve the visibility of the Unit and enhance its international status. The Unit has at its disposal well-equipped laboratories that can be leveraged to establish such international collaborations, leading to enhanced research outcomes for the Unit. The research staff participated in recognized local and international conferences. Despite its many strengths, the Material Engineering Unit has produced a relatively low number of PhD graduates. This may be due in part to the Unit's focus on applied research and the difficulty attracting talented scientists. It is worth considering strategies for increasing the number of PhD students and producing more highly trained scholars and researchers in the field. The Material Engineering Unit relies mainly on low-budget funding from national sources. While this funding is certainly valuable and has enabled the Unit to make many important contributions to the field, it may limit the Unit's ability to pursue more ambitious international research projects or to compete with other institutions for top talent. It is important to form partnerships with influential international researchers to improve the likelihood of obtaining funding for projects on a global scale. The Unit has received very few awards, which is consistent with its limited reach and influence in the wider academic community. There are no patents reported as the best research results in the self-assessment report. The Materials Engineering research field has experienced measurable growth both in terms of its core group and the quality of its research and development activities in recent years. This research group, with the right approach, has the potential to enhance the quality of their work even further. Overall, the Material Engineering research field has a strong faculty with a good research track record, and it has some international recognition.

Economic and social impact of R&D activities of the UoA

Score (points)

4

Reasoned justification of the score

The UoA has secured significant funding for applied research projects with important economic and social implications. The topic of research and development activities is highly relevant to Lithuanian society, particularly in the areas of building materials, structures, and transportation. Researchers from the Unit play a crucial role in driving research and development initiatives related to these fields. They actively participate in various international and national working groups, including expert panels and standardization boards. The Unit is also highly engaged with the academic and wider community, with many memberships in organizations including three in the Lithuanian Academy of Science, and many consultations on important issues. The Unit has primarily been involved in organizing conferences and workshops at a national level. However, it is crucial to enhance its presence on the international stage by hosting more international events. By doing so, the Unit will gain international exposure and provide a platform for a larger number of scientists from academia and industry to actively participate and stay updated with the latest developments in their respective fields. Moreover, these events foster research collaboration, opening doors for fruitful partnerships and knowledge exchange on a global scale. The Unit was active in popularization activities. These activities play a vital role in raising awareness and educating the local community about key elements of sustainable development. In addition, the Unit has entered into numerous agreements with economic entities to provide training, demonstrating its commitment to practical applications of research. Several examples were provided that are consistent with the strong involvement of the Unit's commitment to international collaborations and also the strong alliance of research with economic entities. The Unit's R&D infrastructure is reportedly among the best in Europe, especially in the fields of structural and geotechnical research, which bodes well for its continued success in these areas. However, while many faculty members hold editorial board memberships, most are in regional and lower-quartile journals, which may limit the Unit's recognition and impact. It is important for researchers to recognize that they have reached a level that can elevate their expectations for themselves and the people around them. Conducting groundbreaking research work and publishing mainly in top-ranked journals will enhance their scientific standing and establish them as experts in the public and private sectors. Overall, the Unit is a vital contributor to scientific research and serves as a valuable partner in research and development beyond the academic sphere. Its research has significant implications for society, and its close collaborations with industry, policymakers, and society reflect its commitment to innovation and service.

The development potential of R&D activities of the UoA

Score (points)

4

Reasoned justification of the score

The UoA has a good age balance among its researchers, although the number of female researchers is relatively low. The researchers and PhD students expressed overall satisfaction with the work environment, research opportunities, and research incentives provided by the University. While there are concerns raised by PhD students regarding their employment status, it is important to note that these issues are regulated by national policies and cannot be directly addressed by the Unit. Nonetheless, this matter is of significant

importance as it contributes to the relatively low PhD graduation rate and poses a potential threat to the Unit's ongoing efforts in recruiting more PhD students. The Unit's strategic plan aims to increase its visibility and impact in the academic community by focusing, among others, on internationally funded projects, patents, and international collaborations, and publishing research results of PhD students in prestigious scientific journals. These initiatives show a promising direction for the Unit's growth. The research and development topics being developed are significant and at the forefront of research, and it is recommended that basic research also be included to further strengthen the Unit's research portfolio. Specifically, the Unit is focusing on several highly competitive and currently important areas of research: composite structures, climate-neutral composite materials, smart city, and sustainable development, intelligent decision support systems, developing materials and technologies for additive manufacturing, Bloomberg Initiative for cycling infrastructure, etc. Participation and even initiation of some novel trends in Civil Engineering research (like multiple-criteria decision analysis and artificial intelligence) are also highly appreciated. In these areas, UoA has appropriate competencies and resources and can be a leader in the international research community. The Unit possesses excellent laboratory facilities, especially in the areas of structures, building materials, and geotechnical engineering. Laboratory equipment is used on an open-access basis. This important policy should be applauded since it allows national and international researchers to access advanced facilities and encourages collaboration. It is reported that the laboratories equipment is regularly updated by acquiring new devices and upgrading the previously purchased ones. This commitment is important for establishing international collaboration and securing long-term competitive research funding. The Unit clearly understands what constitutes research excellence and the strategies to achieve it. Overall, the Unit has the potential to maintain its very good ratings, given its strong human resources, strategic planning, well-organized activities, and excellent infrastructure, all of which are expected to support continued high performance over the next five years.

Recommendations for continuity and/or improvement of the activities of the UoA

The Unit is strong internationally with a solid research foundation, highly accomplished faculty, and excellent laboratory facilities. To establish itself among the top international units and maintain a great potential for excellent ratings, the Unit needs to make some key strategic adjustments, including the following:

The Unit should enhance the proportion of publications published in high-impact, top-ranked journals. Publishing in lower-ranked journals limits the impact and visibility of its work within the international academic community. Its researchers conduct groundbreaking research beyond their fields' state of the art. Such work should be published mainly in top-ranked journals, enhancing their scientific standing (much more citations) and establishing them as authorities in the international community. Increased visibility is essential for international research collaborations.

The Unit should increase the number of competitive national and international research-funded projects. Cultivating further international collaborations can help to achieve this. The encouragement of international key researchers to visit the Unit and appreciate its excellent research facilities firsthand will help to facilitate collaborations. This way, the Unit will significantly increase its chances of securing internationally funded research projects. It is also crucial for the Unit to enhance its presence on the international stage by hosting more international events, such as symposiums and conferences. By doing so, the Unit will gain international exposure and provide a platform for numerous scientists from academia and industry to participate and initiate research collaborations.

It is crucial to increase the number of high-quality PhD students. The Unit should adopt a proactive approach toward reforming the existing national regulations concerning the number of PhD students and their employment status and advocating for a more flexible duration of studies. The last two reforms will help improve the Ph.D. graduation rate and attract more talented scientists. It is equally important to develop joint Ph.D. programs with well-known international Universities, which will provide access to a much larger pool of qualified Ph.D. students. It will also make the Unit's PhD programs more attractive to international students. Research collaborations usually are the first step to facilitate these joint programs.

The Unit needs to diversify further its research agenda to include more basic research topics. By diversifying its research efforts and exploring more fundamental research topics, the Unit can further enhance its reputation for groundbreaking and impactful research and contribute to advancing its scientific field. Such a strategy fosters further international collaboration with high-caliber pioneer researchers from around the World. Strong multi-disciplinary research alliances can be formed able to address current and future major issues of the built environment.

2.6. VilniusTech_AMTE Unit of Assessment

Name of the institution	Vilnius Gediminas technical university
Official abbreviation of the name of the institution	VILNIUS TECH
Name of the Institution's unit of assessment (hereinafter – UoA)	Aviation, Mechanics and Transport Engineering
Abbreviation of the UoA name	VilniusTech_AMTE
The scope of the UoA (FTE(SD))	51,03
Research area(s)	T 000 - Technology

Quality of the R&D activities by research fields (groups of research fields) of the UoA

Technology

Research field	Scope (FTE(SD))	Score (points)
T 009 - Mechanical Engineering	33,52	3,5

Reasoned justification of the score

The UoA is strong at national level with appreciable international recognition. VilniusTech_AMTE regroups three entities: Antanas Gustaitis' Aviation Institute, Faculty of Mechanics and Faculty of Transport Engineering. The latter two components have been running the doctoral study programs, which provides the impetus for keeping up the level of R&D activities. In particular, Mechanical Engineering (that counts 69 active personnel with FTE(SD) equal to 33.52) has kept a steady number of doctoral students (with an average of 23 theses in progress each year, and close to 4 defended each year), with the ratio researcher-student that can apparently enable a satisfying research dynamic with good to very-good quality of R&D activities. The main R&D activities are constructed around the topics of control (robots), mechatronic systems and materials, with the push towards further integrating machine learning and biomedical engineering. The Mechanical Engineering group has a starting participation in Horizon project and several ongoing H2020 and regional projects. Research projects with industry have not been presented in detail, although the corresponding budget in that domain indicates a very strong involvement of the members in that respect. The presentation of the recruitment of young researchers (doctoral students and their integration following graduation) has received much larger care as the main focus of the strategy of this UoA for increasing their performance. The publication record is very good, with close to 20% of research papers in Q1 and 40% in Q2 journals. This was stated as the goal set for improvement from the previous evaluation, which has been achieved. Of course, this can further be improved (by inverting these numbers), which should be set as the target for the next evaluation period. This should not totally exclude (locally supported) journals that this is running, nor efforts to help the starting career phase of young researchers that is currently put in place. The members of this research field have obtained a certain number of national and regional awards and competition-based recognitions. The organization of scientific meetings is mostly at the national level (with roughly one international conference per year) and there is a steady stream of yearly meetings.

Research field	Scope (FTE(SD))	Score (points)
T 003 - Transport Engineering	17,51	3,5

Reasoned justification of the score

The UoA is strong at national level with appreciable international recognition. The research carried out in Vilnius Tech - Transport Engineering is relevant and shows good quality, and in some niches, it is even very good, contributing to the competitiveness of the EU in this field. The fragmented structure of the research topics reduces synergies. The rather low number of researchers and professors further reduces this low opportunity for synergies. Some of these niche topics of Transport Engineering are of growing relevance, and one may not expect more in a small country without a well-developed automotive, military or aircraft cluster. For instance, the research focus covers major trends like autonomous steering and other segments of intelligent transport systems, which is illustrated by a majority journal publications and conference attendance. There is a good balance of career-stage levels, which results in good continuity, yet there could be more effort to employ junior researchers. Employed researchers are rather productive.

Doctoral studies are offered. The unit has kept a steady number of doctoral students with a good ratio between researchers and PhD students, which contributes to very good research dynamics. The share of foreign staff (PhD students) is low but slowly growing. A very good program for training the new generation of researchers has been formed.

Within the past 5 years, PhD theses have become less academic and more oriented towards industrial needs, and slightly more towards societal needs. They have also moved forward considerably towards cutting-edge research, but still are written in Lithuanian. The range of addressed technological problems is fairly wide, which allows students to better gain skills and creativity, but the potential synergies stemming from this breadth were not yet well enough exploited.

What was presented as international and national awards, gives a proof of good work in many fields but not of excellence. Membership in foreign and international institutions is quite well developed.

A rather good number of reported articles was published in referenced journals. A good share of the research staff is ranked among the top 2%, showing the high research output. Only some publications provided are in high-ranking journals: more than half of the reported publishing activities refer to journals with lesser outreach and reputation. There is almost no joint publishing together with scientists of other research units. Conference presentations show a wide range of quality between good and very good. Participation in competition-based projects is high, yet the share of the UoA's contribution to these projects is not always clear.

The organization of scientific meetings has mostly remained at national level (with roughly one international conference per year) and a steady stream of yearly meetings. Communications with press and popular media appear regularly at national level.

The Faculty of Transport Engineering was rather successful in receiving EU funding from the Horizon program, and apparently has delivered good work because of follow-up funding granted. Success in European research programs cannot distract concern about underdeveloped international cooperation structures. It would be crucial to do more to attract foreign PhD students, guest researchers and lecturers and to motivate staff and students to more actively make use of Erasmus+ offerings. Interreg activities aiming at the development of the TEN-T program demonstrate that the UoA is well embedded into regional decision-making structures but are of lesser scientific importance. The quality of the research delivered in multi-party projects could be assessed just indirectly via submitted links to articles, because there was no description of

the UoA-specific part (responsibilities, results achieved) in these projects. There is just moderate thematic coherence between the different projects.

Quality of research is good, in some cases even high, but the unit's own share of research carried out in multi-partner projects should have been transparently presented, even deeper collaboration with other affiliated units with suitable specialization and equipment should have been sought to make up for the small size of the Unit, and better use of the potential for synergies in research and in projects would have been possible.

Economic and social impact of R&D activities of the UoA

Score (points)

3,5

Reasoned justification of the score

This UoA was active in seeking H2020 projects (roughly one per year), as well as inter-regional projects, which should confirm its very good reputation and recognition also outside the academic community. Apparently, the contacts with industry have touched upon many different activities (development of prototype, innovative transport, multifunctional satellite, methodologies for facial movement), which could have been presented in a more detailed manner to confirm more than very good economic and social impact of R&D activities. A rather impressive budget of industry contracts indicates an important number of consulting efforts of this Unit, but a better presentation of this potential (or large importance for economic and social impact) was somewhat hindered by a recent moving of experimental facilities to a new university building. There is no doubt that the list of research output for this Unit is very good.

The individual members of this UoA have received a number of personal recognitions, including the Lithuanian Academy memberships, presidents and secretary positions of scientific associations, members of expert groups and committees. In this respect, this UoA is already very good. In fact, the participation of researchers representing the UoA in working groups, commissions or committees is certainly among the strong points for economic and social impact of R&D of this Unit. Currently, the strong points have not been emphasized enough to fully grasp the result excellence.

The consulting activities of this UoA are ample, but they have not received much attention in presentation.

Rather large scientific meetings were organized (close to five per year) and the UoA members hold editorial duties in more than 20 journals. Finally, there is rather dynamic collaboration with companies and other economic entities to complete the spectre of the activities with economic and social impact.

The UoA carries out important research for the society and is significant partner in R&D outside the academic community.

The development potential of R&D activities of the UoA

Score (points)

3,5

Reasoned justification of the score

The strategic activities of this UoA have been selected as follows (with participating components marked in parenthesis): 1. Autonomous vehicles and robots and UAV (TF, MF, AGAI); 2. Unmanned Aerial Vehicles and

Systems (AGAI); 3. Biofuels, emissions, energy efficiency, hybrid, and electric powertrains (TF, MF); 4. Vehicle dynamics, active and passive safety (light / heavy vehicles; railway transport) (TF); 5. Robotics, Machine learning, Artificial Intelligence (MF); 6. Bionics and Biomedical Engineering (MF), The vast majority of these topics either belong or can serve as the basis to the currently mainstream research. The infrastructure is already at a high level to provide the needed support for such development, but it can be improved even further in agreement with strategic plan of this UoA.

Human resources seem to be well balanced in order to provide further increase of R&D activities, given that the majority of researchers are not in the highest age bracket. The selection and funding of young researchers and doctoral students, as well as the effort in further increasing interdisciplinary research can certainly contribute to these goals.

The efforts to recruit the doctoral students are made and integrated within the previous educational stage (*e.g.* with Master students involved in paper writing). The vast majority of doctoral students are funded by scholarships and the expenses of their internships during doctoral studies are fully covered by the university resources. The final strategy of integrating young researchers is the possibility of doctoral students to obtain a faculty position (equivalent to associate professor).

The given SWOT analysis is thorough, credibly representing the strengths, weaknesses, opportunities, and threats of UoA.

Having regard to current performance, the human resources, strategy, and organisation of activities and infrastructure of the UoA will ensure, conditions for good to very good ratings in the next 5 years.

Recommendations for continuity and/or improvement of the activities of the UoA

This UoA has a (very) strong potential for further improvement, which already starts with more coordinated presentation of its activities to any potential partner in the manner where the key strength points are better communicated.

The elements of the strategy of integrating the young researchers (which is now very successful) should further be elaborated and fructified, by preparing the winning project at the level of ERC Starting Grant or ERC Consolidation Grant, with the support and help of the whole UoA.

There is a notable effort to publish in international journals with higher impact factor (roughly 20% in Q1 and 40% in Q2). This tendency should further be strengthened, if possible, to inverse these figures. Such publications could be testing ground for the original ideas that can have the potential to obtain the highest-level international projects.

More effort should be made to make this UoA more attractive to international students and young researchers.

The strategic domains for R&D activities have been selected to cover most of the currently hot research topics in the scientific area of Mechanical or Transport Engineering and Aviation. Here, the topics of special interest for the UoA should better be identified, given that these topics are of interest to top international level. Namely, the smart specialization strategy should be put in place indicating clearly what the advantage is brought for the country and region compared to the similar efforts worldwide.

More efforts should be made in targeting the interdisciplinary topics, those who have potential of federating the research coming from different components to provide the synergy of competence. This can be done at the level of more senior researchers, to provide the basis for larger industry projects and technology transfer.

This UoA has the potential of attracting senior researchers at the highest international level (given the advantage of the central location within the country). This could be done either at long-term recruitments or short-term exchange with the top European teams in the same domain.

The latter would easily be strengthened by mobility of doctoral students and by starting the double doctoral degree, which can be supported by University or numerous mobility programs in Europe. The faculty member should be consulted when deciding a doctoral student mobility, with priority given to the long-term collaborations of this kind.

Special efforts should be made when selecting the conferences to attend, as well as the kind of communications to be presented. The offers to provide invited lectures (keynote or plenary) should be the best opportunity to increase the visibility of the research in this UoA.

The conference organization for young researchers should continue and be further strengthen by combining them with international or regional meetings that this UoA should be able to organize.

3. FINDINGS

Quality of Research

Members of Technological Sciences Panel have visited six UoAs. The evaluation of “Economic and social impact of R&D activities” and “Development Potential of R&D activities” was performed for each entire UoA. The “Quality of R&D activities” was evaluated according to research field (group of research fields) within the UoA. The whole procedure was designed to make the assessment of each individual research team within the UoA. This evaluation covered fields of Civil Engineering (T002), Transport Engineering (T003), Environmental Engineering (T004), Chemical Engineering (T005), Energetics and Power Engineering (T006), Materials Engineering (T008), Mechanical Engineering (T009), and Measurement Engineering (T010).

All universities, technical universities and the evaluated research institute performed equally well. This suggests that the form of organization does not play a crucial role in the quality of the research. There is obvious a positive sign of collaboration between different types of scientific organizations (research Institute and Universities, particularly) and that kind of activity should be further supported and promoted.

The evaluators’ on-site visits of UoAs revealed a wide variety of fundamental and applied research performed by research organizations and largely confirmed the content of their reports. There is an obvious positive tendency of all research units to perform applied studies and transfer knowledge to industry. At the same time, fundamental research is less prioritized. This was particularly reflected, in the rather limited number of publications in the high-impact journals. Focusing on applied research complicates attracting international students and young researchers, and narrows international recognition of the work done. It is important to keep in mind that one of the roles of the universities is to produce new fundamental knowledge, sometimes purely academic, that will be applied in the future.

Panel has found that among the evaluated UoAs that 23% were considered to have quality of R&D activities at strong national level with limited international recognition (score=3). About half (46%) of the UoAs have quality of R&D activities with somewhat better international recognition (score=3.5), and about one third (31%) are strong at international level (score=4). While the outcome of the evaluation of quality of R&D activities is positive and impressive, no top international players were found among all UoAs.

There is no obvious heterogeneity in the quality of R&D activities between research teams within the same UoA. However, there is a tendency of larger groups to perform better. Suffering due to a relatively small size and certain degree of scientific isolation is especially visible for small groups working in the fields of Chemical Engineering and Measurement Engineering.

Knowledge transfer

The socio-economic impact of research activities of all UoA is obvious. The panel agreed that all scientific teams do maintain communication ties in Lithuanian society, and some are actively working at larger European level. Scientists of the UoAs are well engaged with the Lithuanian academy of science, ministries, commission of standardization, and consulting of businesses. Especially appreciated is the contribution of Environmental Engineering and Energetics and Power Engineering groups in developing green and alternative energetics, energy saving technologies, and smart technology projects.

When cooperating with the industrial sector, the UoAs should exclusively focus on R&D including problem solving and development of ideas instead of carrying out service functions which could also be covered by commercial firms.

Evaluated UoAs are well-recognized at the national level as documented by numerous awards. Members of the UoA participate in numerous scientific conferences, meetings, and workshops at national and international level. There are few examples of international meetings organized by some groups or participation of individual scientists in organization committees. More effort should be invested into these activities. Considering the geographical location of Lithuania and the country's well-developed infrastructure, there is a good potential for organizing European and international conferences. That may be highly beneficial for increasing of the socio-economic impact of research activities of the UoAs.

All groups are committed to promoting science through various science popularization activities at mostly national media. Although some UoAs are present in social networks, their activity in these media is not sufficient, especially considering the large number of projects implemented, and the UoA's should make better use of the ability of social media to run a dialogue.

Most (83%) of the UoAs demonstrate socio-economic impact of research activities at good (score=3.5) or very good level (score=4).

Infrastructure, funding, management, human resources

Many of UoAs evaluated have benefited from exceptional financing programs in recent years, so their level of equipment is very good and in parts even excellent. Additionally, the UoAs' staff has good direct access to national and international equipment through participation in various alliances and associations. A number of UoAs is engaged in different international organizations and associations, which increase the internationalization degree by promoting exchange of knowledge and staff, making these groups more visible in European science. Openness of facilities and laboratories to researchers from different groups within the UoAs and across universities (including wider range of European Universities and institutions) is important for cultivating innovation in research and developing new ideas and therefore should be supported even more.

In general, in the UoAs concerned, personnel is balanced among researchers and other employees with a centroid at the very productive R&D period. However, the numbers of research fellows (including those from abroad), junior researchers, and PhD students, especially from abroad, are insufficient. For some UoAs gender imbalance with an underrepresentation of women needs particular attention and actions for future development.

Management principles on recruitment are properly based on open competitions under the rule that all procedures are transparent, non-discriminatory, and inclusive. PhD studies and PhD students are at the core of the process and of particular consideration in UoAs' recruitment plans with novel motivation channels and attraction networks for talented new staff. However, all evaluated UoAs should increase their effort to encourage young post-graduate researchers to continue their scientific careers in Lithuania.

The strategic objectives of the evaluated UoAs are well established with applied engineering and technology-based activities at the forefront of research and sustainable development in the respective fields. There are plans to strengthen their research activities with directional competence improvement to global issues of energy transition and climate change. Current research fields that are closely related to the priority tasks of EU, such as climate change, circular economy, efficient use of resources, security of energy supply, public health, healthy food, etc., will gain even more importance. However, this envisioned expansion requires a considerable increase of the available manpower, especially doctoral students, in the respective disciplines.

The Panel found that all of the evaluated UoAs have strong development potential of R&D activities (scores 3.5 or 4).

Recommendations

The Panel has concluded that some critical strategic adjustments could help the evaluated UoAs to establish themselves among the top international units.

The UoAs should enhance the number and proportion of publications in high-impact, top-ranked journals. It is clear that researchers are motivated to publish in Q1 and Q2 peer reviewed journals. However, some journals included in these categories can hardly be considered as top-ranked. The management of the UoAs and/or Lithuanian scientific bodies should be more critical in identifying top journals in each scientific field and do their best to avoid sending misleading message to the researchers.

The UoAs should work harder in order to receive a higher number of competitive international research-funded projects. National research funding and national co-financing of international flagship projects should be increased significantly. International research funding is becoming increasingly competitive, and national research funding is essential to keep Lithuanian researchers active. Cultivating further international collaborations can help to secure more international research funding. The researchers should be encouraged to visit key international institutions through paid sabbaticals. The UoAs should establish short and long-term visiting positions to host well-established international researchers. This way, the UoAs will significantly increase their chances of securing internationally funded research projects.

To enhance their research agenda, the UoAs should prioritize diversification by including a broader range of fundamental research topics. Enhancing the internal collaboration of the UoAs' members should help to avoid work in "scarce" research fields. While addressing the challenges of the local industry through applied research is essential, it is equally vital for the research teams to lay the groundwork for future advancements. To achieve this, promoting multi-disciplinary research alliances is imperative, enabling the UoAs to tackle current and future societal challenges more effectively and collaboratively. National funding should be provided for these topics.

It is crucial to increase the number of high-quality PhD students. The Panel advises the Research Council of Lithuania to reform the existing national regulations concerning the number of PhD students and their employment status. It is vital to increase significantly the funding for this category of young scientists and to invest into promotion of PhD studies. It is unnecessary to regulate all aspects of PhD studies nationally, including the duration of studies. The UoAs should be encouraged to develop joint PhD programs with well-known international universities, providing access to a much larger pool of qualified PhD programs. It will also allow the local PhD students to work abroad and gain vital international exposure.

